

## **Science questions and broad outline of technology needs of the decade 2013-2022**

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**Introduction:** We present an overview of the top priority science questions outlined in the Planetary Exploration Decadal Survey, "Vision and Voyages for Planetary Science in the Decade 2013-2022." The recommended mission portfolio, along with expected infrastructure challenges, should drive investments over the decade. The instrument and technology needs for the next decade will be presented, with a summary of progress since the Decadal.

**Science Themes:** In the process of combining the priorities of each science subpanel (Inner Planets, Mars, Giant Planets, Giant Planet Satellites and Primitive Bodies), three crosscutting science themes emerged: Build New Worlds, Planetary Habitats and Workings of Solar Systems. These themes arose from the synergies across the panels' top priority science goals for the decade. The fundamental science questions for each discipline, and target destinations, map from these themes.

**Recommended Mission Portfolio:** As was allowed in previous calls, this Decadal recommends that Discovery-class missions remain open to all targets and architectures. For the much larger New Frontiers and Flagship class missions, a prioritized list of targets was defined, with some missions deferred to the next Decadal for consideration. Under this scheme, the Mars Sample Return Caching Rover was listed as the top priority Flagship, followed by Europa, a Uranus orbiter and then Venus and Enceladus with no relative priority. New Frontiers class targets included the Lunar South Pole Aitken Basin Sample Return, Comet Surface Sample Return, Saturn Probe, Trojan Tour and Venus In

Situ Explorer. If future opportunities and budgets allow, an Io Explorer and Lunar Geophysical network could be added to later calls. It should be emphasized that it was recognized that all of these missions would not fit into the decade, and the actual budget portfolio would dictate the number of opportunities. However, it was felt that smaller missions should be preserved at a frequent cadence, if at all possible.

**Deferred missions:** Other high priority missions such as the Titan Saturn System Mission, a Neptune Orbiter and Probe, Ganymede Orbiter, Mars Geophysical Network, and remaining the components of Mars Sample Return were deferred to future decades.

**Infrastructure Challenges:** There are many challenges facing missions in the next decade. These include limited downlink communication availability, particularly as the Deep Space Network 70-m dishes age, and increasing desire to reduce the mass and power needs of payloads and spacecraft. The outer solar system is particularly sensitive to the need for new power generation techniques, high capability launch vehicles, and advanced propulsion, though all destinations can benefit from such advances.

**Instrument Needs:** The science goals and questions, along with the above infrastructure challenges, will further drive the need for robust technology development, particularly for advanced instruments. A key finding of the Decadal was the need to support a mid-TRL development program, to mature instruments to the state needed for future missions.